IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Koji YOSHIDA, et al
Title:	METHOD OF DETERMINING MOVEMENT SEQUENCE, ALIGNMENT APPARATUS, METHOD AND APPARATUS OF DESIGNING OPTICAL SYSTEM, AND MEDIUM IN WHICH PROGRAM REALIZING THE DESIGNING METHOD
Serial No.:	Unassigned
Filing Date:	July 9, 2001
Examiner:	Unassigned
Art Unit:	Unassigned

PRELIMINARY AMENDMENT

Commissioner for Patents
Box PATENT APPLICATION
Washington, D.C. 20231

Sir:

Prior to examination of the present Continuing Application, Applicant respectfully requests that the application be amended as follows:

In the Specification:

Please amend the specification by replacing the indicated paragraphs with the following clean versions. (See **Attachment A** for the marked up version of the amended specification.)

After the Application Title, please insert:

--This is a Continuation Application of Application No. 09/023,204, filed February 13, 1998.—

Page 86, first full paragraph

In this embodiment UNDX (Ono, I. And Kobayashi, S: A Real-coded Genetic Algorithm for Function Optimization Using Unimodal Normal Distribution Crossover, Proceeding of 7th International Conference on Genetic Algorithms, pp. 246-253 (1997)) is adopted as a crossover operator. The UNDX generates, from two parents of parent 1 and Parent 2 out of selected parents, two children according to a normal distribution set around them, as shown in Fig. 27. The standard deviation of the normal distribution is set so that a component $\sigma 1$ along the major-axis direction connecting the both parents is proportional to a distance between the parents ($\sigma 1 = \alpha d1$ where d1: the distance between Parent 1 and parent 2) and so that a component $\sigma 2$ along the other axis is proportional to a distance between the major axis and Parent 2 ($\sigma 2 = ßd2$, where d2: the distance between parent 3 and the axis connecting parent 1 with Parent 2). Fig. 27 illustrates an example of two variables.

Page 92, second full paragraph

Fig. 38 shows a state in which the best solution P (the lens system shown in Fig. 31) obtained in Experiment 1 of the first embodiment described above is plotted on the enlarged view of Fig 37. In the drawing letter Q indicates lens systems dominating the solution found by the single-objective optimization of the evaluation criteria. As also apparent from this Fig. 38, it is clearly seen that the second embodiment (multi-objective optimization) obtains many more excellent solutions that that obtained by the single-objective GA. This conceivably suggests that there is a possibility of making the problem harder if the multi-objective problem is forced to the single-objective problem.

Page 96, first full paragraph

Fig. 39 is a schematic diagram of the structure of the photographic lens system. In this figure g designates the image plane. The photographic lens system of this figure is an example of the three-lens configuration, in which there are six boundary surfaces of a to f having their respective curvatures, and six distances of d1 to d6 between the boundary surfaces (d1 between A and B, d2 between B and C, d3

between C and D, d4 between D and E, d5 between E and F, and d6 between F and G).

Page 100, second full paragraph

Fig. 41 illustrates a gene representation of ten parameters of continuous values featuring the lens system in the three-lens configuration shown in Fig. 39. In each of a-e and d1-d5 in the same drawing a parameter of the corresponding lens system is stored in the form of continuous value. Among such genes, n ($n > 1$) genes satisfying the minimum constraints are reproduced arbitrarily.

Page 112, first full paragraph

The n-dimensional coordinates of the point P4 reproduced by above steps ST4-1 to ST4-6 correspond to the n parameters a, b, c, d, e, d1, d2, d3, d4, d5 of a chromosome of a new-born gene or a child. In this step ST4 of the fourth embodiment the substeps ST4-1 to ST4-6 described above are repeated m times, whereby m new genes are reproduced from the three parents Pa1, Pa2, Pa3.

Page 116, second full paragraph

In the case of the multi-objective optimization, steps ST110 and ST150-ST170 below are executed in place of above steps ST1 and ST5-ST7.

Page 122, second full paragraph, lines 7-13

Size of initial population: 50

Number of Crossovers: 300,000

Number of children generated by crossover operator: 20

σa of UNDX: 0.5 x VC1VC2

σb of UNDX: 1

σc of UNDX: 0.35 x $(VC1VC2)^{1/n}$

In the Claims:

Please cancel claims 19-41 without prejudice or disclaimer.

Please add the following new claims:

--42. (New) A mark detecting method of sequentially detecting a plurality of areas to be detected on a substrate by using a detecting device having a predetermined detecting field, said method comprising steps of:

a determining step of determining an order for positioning each of the areas to be detected into the predetermined detecting field by using at least one of an operations-research technique and an evolutionary computation method; and

a movement step of moving the substrate so as to sequentially position each of the areas to be detected into the predetermined detecting field in accordance with the order determined in said determining step.

43. (New) The method according to claim 42, wherein the order determined in said determining step is a solution of a most preferable movement sequence, based on an overall movement time between the areas to be detected.

44. (New) The method according to claim 43, wherein said determining step comprises:

a first step of generating a group including a plurality of executable movement sequences out of a group of movement sequence candidates each indicating a visiting order of the areas to be detected; and

a second step of selecting a movement sequence that accomplish a movement operation between the areas to be detected in the shortest time, out of said group generated in said first step.

45. (New) The method according to claim 42, wherein the evolutionary computation method includes a genetic algorithm.

46. (New) The method according to claim 42, wherein the operations-research technique includes at least one of a linear programming method, a Lin and Kernighan's approach, and a k-OPT method.

47. (New) The method according to claim 42, wherein each of the areas to be detected has an alignment mark.

48. (New) The method according to claim 47, wherein a plurality of shot area are provided on the substrate, each of the alignment marks in the areas to be detected is associated with one of the shot areas, and each of the shot areas has ones of the alignment marks in the areas to be detected.

49. (New) A method of exposing a predetermined pattern onto a plurality of shot areas on a substrate, said method comprising:

detecting a plurality of alignment marks by using said mark detecting method according to claim 47;

controlling a position of the substrate, based on the detected results in said detection of alignment mark; and

sequentially transferring the predetermined pattern onto the shot areas.

50. (New) A method of manufacturing a device, comprising sequentially transferring a device pattern onto a plurality of shot areas by using said method according to claim 49.

51. (New) A mark detecting method of detecting a plurality of measurement marks associated with a plurality of shot areas arranged on a substrate, said method comprising the steps of:

a first step of detecting at least one of a plurality of first measurement marks provided associated with a predetermined shot area out of the shot areas; and

a second step of detecting at least one of a plurality of second measurement marks provided associated with a shot area different from the predetermined shot area, before detecting all of the first measurement marks.

52. (New) The method according to clam 51, further comprising a third step of detecting one or amore remaining first measurement marks which are not detected in said first step, after said second step.

53. (New) A method of exposing a predetermined pattern onto a plurality of shot areas on a substrate, said method comprising:

detecting a plurality of measurement marks by using said method according to claim 52;

controlling a relative position between each of the shot areas on the substrate and the predetermined pattern, based on the detected results in said detection of alignment mark; and

sequentially transferring the predetermined pattern onto the shot areas.

54. (New) A method of manufacturing a device, comprising sequentially transferring a device pattern onto a plurality of shot areas by using said method according to claim 52.

55. (New) A mark detecting apparatus which sequentially detects a plurality of areas to be detected on a substrate by using a detecting device having a predetermined detecting field, said apparatus comprising:

a determining device which determines an order for positioning each of the areas to be detected into the predetermined detecting field by using at least one of operations-research technique and an evolutionary computation method; and

a movement device which is electrically connected to the determining device and which moves the substrate so as to sequentially position each of the areas to be detected into the predetermined detecting field, based on the order determined by said determining device.

56. (New) The apparatus according to claim 55, wherein the order determined by said determining device is a solution of a most preferable movement sequence, based on an overall movement time between said areas.

57. (New) The apparatus according to claim 56, wherein the evolutionary computation method includes a genetic algorithm.

58. (New) The apparatus according to claim 56, wherein the operations-research technique includes at least one of a linear programming method, an Lin and Kernighan's approach, and a k-OPT method.

59. (New) The apparatus according to claim 56, wherein each of the areas to be detected has an alignment mark.

60. (New) The apparatus according to claim 59, wherein a plurality of shot areas are provided on the substrate, each of the alignment marks in the areas to be detected is associated with one of the shot areas, and each of the shot areas has ones of the alignment marks in the areas to be detected.

61. (New) An exposure apparatus that sequentially exposes a predetermined pattern onto a plurality of shot areas on a substrate, said exposure apparatus comprising said apparatus according to claim 59,

wherein said exposure apparatus detects a plurality of alignment marks by using said detecting apparatus, controls a position of the substrate, based on the detected results in the detection of alignment mark, and sequentially transfers the predetermined pattern onto the shot areas.

62. (New) A mark detecting apparatus which detects a plurality of measurement marks associated with a plurality of shot areas arranged on a substrate, said apparatus comprising:

a detecting device that detects at least one of a plurality of first measurement marks provided associated with a predetermined shot area out of the shot areas; and

a control device, electrically connected to said detecting device, that controls said detecting device to detect at least one of a plurality of second measurement marks associated with a shot area different from the predetermined shot area, before detecting all of the first measurement marks.

63. (New) The apparatus according to claim 62, wherein said control device controls said detecting device to detect a part of the first measurement marks, detect second measurement marks after detecting the part of the first measurement marks, and detect one or more remaining first measurement marks other than the part of the first measurement marks, after detecting the second measurement marks.

64. (New) An exposure apparatus that exposes a predetermined pattern onto a plurality of shot areas on said substrate, said exposure apparatus comprising said detecting apparatus according to claim 63,

wherein said exposure apparatus detects a plurality of measurement marks by using said detecting apparatus, controls a relative position between each of the shot areas on the substrate and the predetermined pattern, based on detected results in said detection of measurement marks by using said detecting apparatus, and sequentially transfers the predetermined pattern onto the shot areas.--

Atty. Dkt. No. 061807-0137

REMARKS

Applicant respectfully requests that the foregoing amendments be made prior to examination of the present application.

After amending the claims as set forth above, claims 1-18 and 42-64 are now pending in this application.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date July 9, 2001

By Aaron C. Chatterjee Reg# 41,398

for David A. Blumenthal
Attorney for Applicant
Registration No. 26,257

FOLEY & LARDNER
Washington Harbour
3000 K Street, N.W., Suite 500
Washington, D.C. 20007-5109
Telephone: (202) 672-5407
Facsimile: (202) 672-5399

Attached: Attachment A

Should additional fees be necessary in connection with the filing of this paper, or if a petition for extension of time is required for timely acceptance of same, the Commissioner is hereby authorized to charge deposit account No. 19-0741 for any such fees; and applicant hereby petitions for any needed extension of time.

002.606201.1

Marked up version of specification changes in Preliminary Amendment filed on July 9, 2001

Page 86, first full paragraph

In this embodiment UNDX (Ono, I. And Kobayashi, S: A Real-coded Genetic Algorithm for Function Optimization Using Unimodal Normal Distribution Crossover, Proceeding of 7th International Conference on Genetic Algorithms, pp. 246-253 (1997)) is adopted as a crossover operator. The UNDX generates, from two parents of parent 1 and Parent 2 out of selected parents, two children according to a normal distribution set around them, as shown in Fig. 27. The standard deviation of the normal distribution is set so that a component $\sigma 1$ along the major-axis direction connecting the both parents is proportional to a distance between the parents ($\sigma 1 = \alpha d1$ where d1: the distance between Parent 1 and parent 2) and so that a component $\sigma 2$ along the other axis is proportional to a distance between the major axis and Parent 2 (σ 2 = ßd[3]2, where d[3]2: the distance between parent 3 and the axis connecting parent 1 with Parent 2). Fig. 27 illustrates an example of two variables.

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Fig. 38 shows a state in which the best solution P (the lens system shown in Fig. 31) obtained in Experiment 1 of the first embodiment described above is plotted on the enlarged view of Fig 37. In the drawing letter [S]Q indicates lens systems dominating the solution found by the single-objective optimization of the evaluation criteria. As also apparent from this Fig. 38, it is clearly seen that the second embodiment (multi-objective optimization) obtains many more excellent solutions that that obtained by the single-objective GA. This conceivably suggests that there is a possibility of making the problem harder if the multi-objective problem is forced to the single-objective problem.

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Page 112, first full paragraph

The n-dimensional coordinates of the point P4 reproduced by above steps ST4-1 to ST4-6 correspond to the n parameters a, b, c, d, e, [f,] d1, d2, d3, d4, d5 of a chromosome of a new-born gene or a child. In this step ST4 of the fourth embodiment the substeps ST4-1 to ST4-6 described above are repeated m times, whereby m new genes are reproduced from the three parents Pa1, Pa2, Pa3.

Page 116, second full paragraph

In the case of the multi-objective optimization, steps [S11] ST110 and [S15 AND S17] ST150-ST170 below are executed in place of above steps ST1 and ST5-ST7.

Page 122, second full paragraph, lines 7-13

Size of initial population: 50

Number of Crossovers: 300,000

Number of children generated by crossover operator: 20

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